general classification of Gasteropoda and Pelecypoda (Lamellibranchiata), including both fossil and recent forms, which has hitherto been attempted. This classification was largely supplemented by original anatomical research, and it has been adopted in one, at least—we believe in two—of the principal museums in Germany.

Dr. Stoliczka was born in Moravia in May 1838. After completing his university course he joined, whilst quite young, the Imperial Geological Institute of Austria, where he soon distinguished himself by his palæontological work, and became especially known for researches amongst the Bryozoa, fossil and recent. The collection of specimens belonging to that class obtained by the Novara expedition was intrusted to him for description. Amongst his principal early contributions to palæontology were papers on the fossil fauna of the Hierlatz and Gosau beds.

In 1862 he joined the Geological Survey of India, and at once commenced the study of the magnificent series of Cretaceous fossils obtained by Messrs. H. F. Blanford, C. Oldham, and the other officers of the Survey engaged in the Madras Presidency. The descriptions of these fossils have only recently been completed, and extend altogether to about 1,500 quarto pages illustrated by 178 plates. There can be no doubt of the rank of this work; it is one of the most complete monographs ever published of any fossil fauna whatever. The numerous duties connected with the post of Palæontologist to the Survey occupied so much of Dr. Stoliczka's time that he was only able to devote a few months in three different years to field-work. To this field-work we owe valuable reports on the western Himalayas, Thibet, and Kachh, the last not yet published. In the year 1868 he accepted the honorary secretaryship of the Asiatic Society, and during the five years he held the post he raised the natural history portion of the Society's journal to a position it had never approached before, this improvement being due no less to his own contributions than to the aid he was always ready to afford to all engaged in zoological inquiry.

When, last year, a mission was despatched by the Indian Government to Yarkund and Kashgar, Dr. Stoliczka was selected to accompany it as naturalist and geologist. It would have been impossible to have found anyone more competent for the post, but many of his friends knew the risk he ran, and he was well aware of it himself, for his health had been seriously affected by exposure in former years in the higher regions of the Himalayas, and he needed rest and a change to Europe. His life has been a sacrifice to the study to which he had devoted it. He was seriously ill at one time when crossing the high passes on his way to Yarkund, but recovered, and his letters from Kashgar gave glowing accounts of his discoveries, and now when returning loaded with the spoils and notes of nearly a year's research in one of the least-known parts of Central Asia he has fallen, just as his friends were in hopes of welcoming him back amongst them. This is not the place to speak of his many amiable qualities, but few men were more widely known in India or more universally beloved and esteemed, and the gap he has left in the little band of Indian naturalists and geologists, as well as amongst the far wider circle of his private friends, will be long unfilled. W. T. B.

OBSERVATORIES IN THE UNITED STATES

ONE of the most salient points in the scientific progress of America is undoubtedly the marvellous multiplication of first-class observatories during recent years. The genius of her people, the skill of her artists, and the wise liberality of states and individuals have combined to bring about a state of things which those interested in Astronomy in any country on this side of the Atlantic may regard with the intensest envy. Undoubtedly our own observatories are already distanced in everything except activity. In number, instrumental equipment, breadth of design, the American institutions are unsurpassed; and although the Americans themselves say they want men with such world-wide names as Peirce, Winlock, Newcomb, Young, Peters, and many others that we might mention, who know no resting on old laurels, it is difficult for an Englishman to acknowledge that the idea is well founded.

A very interesting and well-illustrated article on United States Observatories appears in a recent number of *Harper's Monthly*. Some of the illustrations, which we are enabled to give by the courtesy of the Editor, give a good idea of the scientific wealth to which we refer, and of the progress that has been made, for while little more than thirty years ago it could not be said that there was one astronomical observatory in the United States, to-day it is safe to place the number of all classes, public and private, beyond fifty.

Cincinnati Observatory.—One of the most strenuous advocates for the establishment of public observatories in the United States was John Quincy Adams, who had made astronomy a favourite pursuit. He had very just conceptions of what ought to be the character and aims of a true observatory. It must steadily labour for *discovery*. It must be fully equipped for this, and be provided with a *personnel* who could give their whole energies to that series of observations, running through many years, which alone can secure valuable additions to astronomical knowledge and insure its benefits to men. For the establishment of such an institution he had made his well-known appeal to Congress in 1825. He was ridiculed; but he remained as strenuous an advocate as ever for the establishment of observatories of the first class both at Washington and at Cambridge. In the very year before this address at Cincinnati he had urged, in his place in Congress, the perpetual appropriation of the whole interest of the then unappropriated Smithsonian fund for an observatory for the people.

"The express object of observatories," said he, "is the increase of knowledge by new discovery. It is to the successive discoveries of persevering astronomical observations through a period of fifty centuries that we are indebted for a permanent standard of time and for the measurement of space."

The year 1843 was, however, an era in the history of United States observatories, and Cincinnati was their birthplace. Her institution and those of Cambridge and Washington sprang up, and the enthusiasm of the era started others, whose equipment has been secured largely by their success.

As early as 1805, Cincinnati may be said to have had a practical working observatory. In that year the first Surveyor-General of the United States, Colonel Jared Mansfield, received, after a delay of at least three years in their construction and transportation from London, astronomical instruments ordered by Albert Gallatin, Secretary of the Treasury, and paid for by President Jefferson out of his *own contingent fund*, "since no appropriation for them had been made by law." The instruments, which were said to have been excellent of their kind, were a 3-foot reflecting telescope, a 30-inch portable transit instrument, and an astronomical pendulum clock. Years afterward, they were placed in the philosophical department of the Military Academy at West Point. In the house of the Surveyor-General, at Cincinnati, they were used in making numerous and interesting astronomical observations. The orbit of the comet of 1807 was calculated, eclipses of different kinds were observed, the longitude of the observatory determined, and other observations of importance made from 1807 to 1813, all of them outside of the usual duties of the mere surveyor.

Our next date is at the end of the lapse of forty years. We are brought then to the marked era in astronomical interest already referred to, and to the labours of those who awakened that interest, especially of Ormsby M'Knight Mitchell.

Mitchell was a native of Kentucky. He graduated with honour at West Point, in 1829. Resigning from the army, and practising law in Cincinnati, he was made professor in the City College. He was an enthusiast in astronomy. He gave a series of lectures to the citizens in 1842, which created their Astronomical Society.

As the astronomer of the Society engaged for a ten-years' work, Prof. Mitchell sailed for Europe to purchase a telescope superior to any then in America. In the optical institute of Merz and Mähler, successors of the great Fraunhofer, at Munich, he found an object-glass of 12-inch aperture, which, after Lamont's test in his own tube, was pronounced superior to that of the Munich telescope. It was mounted, purchased for about 9,400 dols., and arrived in Cincinnati in 1845.

The Astronomical Society of that town meanwhile had secured from their fellow-citizen, N. Longworth, the gift of four acres of ground on one of the beautiful and commanding hills on the east of the city, and a fund of 11,000 dols. in shares of 25 dols. each.

Prof. Mitchell, on his return, devoted his whole energies to the erection of an observatory. Its corner-stone was laid November 10, 1843, on the site given by Longworth, on Mount Adams.

The observatory presented a front of eighty feet, ornamented with a Grecian Doric portico, and a depth of thirty, showing a basement and two storeys, with a central dome, covering an equatorial room twenty-five feet square, the roof being capable of entire removal when observations were to be made. The object-glass of the telescope had, as we have said, an aperture of twelve inches; its focal length was seventeen feet.

The equatorial room received the Munich instruments in March 1845. Prof. Mitchell began his labours with the enthusiasm of hope. Other necessary instruments were received: a 5-foot Troughton transit, lent by the Coast Survey, an astronomical clock, presented by Mr. M'Grew, of Cincinnati, and a chronometer lent by Messrs. Blunt, of New York. At the request of Prof. Bache, the telegraph company connected the observatory with their stations for the determination of longitude, Cincinnati being then a central point in such work. The Astronomer Royal, under whose instruction Mitchell had passed three months in 1842, urged, in an encouraging letter, that "the first application of his meridional instruments should be for the exact determination of his geographical latitude and longitude, and that his observing energies should be given to the large equatorial." With this advice, he directed his attention largely to the remeasurement of Struve's double stars south of the equator.

Airy and Lamont had invited him to make minute observations of the satellites of Saturn, since in the latitude of Cincinnati the planet is observed at a more favourable altitude than at Pulkova, twenty degrees farther north. To these, and chiefly "to the physical association of the double, triple, and multiple suns," he gave his close attention. He made interesting discoveries in the course of this review. "Stars which Struve had marked as oblong, were divided and measured; others marked double were found to be triple." He proposed a new method for observing, and new machinery for recording north polar distances or declinations. Prof. Peirce reported favourably on this method at the meeting of the American Association in 1851, and Prof. Bache, as Superintendent of the Coast Survey, indorsed their approval in his report for that year, presenting also a full account of work done by the new method, in observations made by the enthusiastic astronomer and his patient wife, who assisted him through all. It was claimed that the results rivalled the best work done at Pulkova. Mitchell was the first "to prepare a circuit interrupter with an eight-day clock, and to use it to graduate the running fillet of paper;" and to invent and use the revolving-disk chronograph, for recording the dates of star signals. Profs. Bache and Walker had declined to adopt the first of these improvements in astronomical appliances, through an apprehension of injury to the astronomical clock. Mitchell's work proved the apprehension to be groundless. His revolving disk is an invaluable invention. To the perfection of such methods and instruments, together with the routine work of observation, he gave all the energies not of necessity employed in outside labours devolving on him for his support. Unhappily these, at an early date, became almost absorbing. For the Astronomical Society, having secured their observatory and their director, had failed to secure a basis for his support. Mitchell relied on his professorship in the Cincinnati College: in two years the college was burnt down. He then relied on publications and lectures. He published the *Sidereal Messenger*, a work of three volumes. He delivered lectures of rare power and beauty in the chief cities of the Union. He stirred up an enthusiasm by these lectures, which quickened the movements resulting in the establishment of some of the first observatories of this day in the United States. But for his support, unhappily for the observatory, he was compelled to accept the position of chief engineer of the Mississippi and Ohio Railroad from 1848-52; and finally, in 1853, that of director of the magnificent Dudley Observatory at Albany, New York. He did not, however, remove from Cincinnati till 1859. In 1861 his country claimed him from astronomy for her own service. The observatory remained in charge of Mr. Henry Twitchell, of Cincinnati, who was Mitchell's chief assistant for twelve years.

On February 1, 1869, Mr. Cleveland Abbe, formerly employed at the Pulkova Observatory, and more recently at the United States Naval Observatory at Washington, accepted the place of director. His first annual report submitted a plan of wide and useful astronomical and magnetic and geodetic investigations. On these he entered vigorously. He first adopted for the United States the issuing of daily meteorological bulletins, now so widely known as adopted and used by the United States Signal Service Bureau.

During the years since Prof. Mitchell's leaving the institution, its future had appeared dark enough. In taking charge of the Dudley Observatory in 1859 he announced his expectation that "the Cincinnati Observatory was soon to be placed on a permanent foundation, and that each observatory would be occupied on a star catalogue down to the tenth magnitude." But it is not surprising that the interval of the war should retard the plans he had formed, and prevent, under all circumstances, their subsequent execution by his successors.

But in 1870 a movement was originated by Abbe, which, at the time this article was written, promises by its development to secure results worthy of the noble founder of the observatory, and of the West. A tripartite agreement has been secured between Mr. Longworth's heirs, the Astronomical Society, and the city, by which the sale of the old site was permitted, and the city pledged to maintain the observatory in connection with the university; original investigations, and not mere educational uses being guaranteed as its object. On Mount Lookout, one, of the highest points in Hamilton County, adjacent to a park not likely to be built up to the injury of astronomical observations, the corner-stone of the new observatory was laid, August 28, by the mayor of Cincinnati. The observatory is to be 71 ft. by 56 ft., with an elevation of 60 ft. It will be built of brick, trimmed with freestone. The pier of the Munich equatorial is to be of solid brick, with like capping; its height 36 ft., and its diameter 17 ft. The iron revolving turret dome adds half a storey. The meridional instruments occupy the wings.

The whole new enterprise owes its success thus far to the munificence of Mr. John Kilgour, of Cincinnati, who granted the site and a liberal grant of money. Cincinna holds that she has good ground of expectancy of success. What they need, what every observatory needs, is, first of all, an astronomer with provision for his maintenance, that he may be "free from other avocations and cares."

FIG. 1.—Ormsby McKnight Mitchell.

A true astronomer, then, first of all—before even the most imposing edifice or instruments. An astronomer with a true conception of his work, with the splendid objects before him, and the advantages of our day, may largely repay the benefactions of the liberal by the lasting benefits not of mere theory, but of the practical usefulness of discovery.

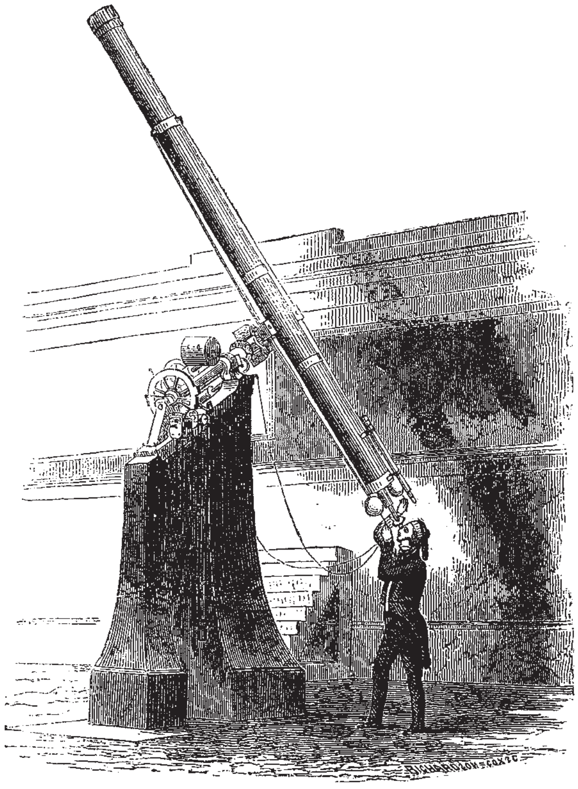

FIG. 2.—The Equatorial of Cincinnati Observatory.

The U.S. Naval Observatory.—The history of this Observatory is not a little remarkable.

Close on the isle on which stood what was known as the "Washington property," near the old Capitol, stood, in 1833, an unpretending wooden building but 16 ft. square, erected at the expense of a lieutenant of the navy, and equipped with a 5-foot Troughton transit instrument. This was the United States Naval Observatory in embryo.

The transit was one of the instruments made for the Coast Survey, under the supervision of Mr. Hassler, its first superintendent, during his long detention in England, by the breaking out of the war. Returning only in 1815, and the survey itself being soon arrested by Congress, his instruments and the "fixed observatory," the establishment of which he was the very first in the United States to propose, rested quietly *in statu quo ante bellum.* In 1832 the Coast Survey was revived; but as an observatory was peremptorily forbidden by the law, the transit was lent to Lieut. Wilkes for his observations.

Lieut. Wilkes's observations were, however, at first only for obtaining clock errors, needed for determining the true time for rating the naval chronometers then under his charge. This testing of all the chronometers and other naval instruments used by the United States ships (begun in 1830 by Lieut. Goldsborough) had been at once found a wise and useful economy for the navy. The Secretary, therefore, established this little receptacle for charts and instruments by placing an officer in charge' permitting him to build his own little observatory and do his own work. The "Depôt" was the christening then given to the establishment. This was all that Wilkes or any one of his successors dared call it even as late as 1842, when establishing the present astronomical institution.

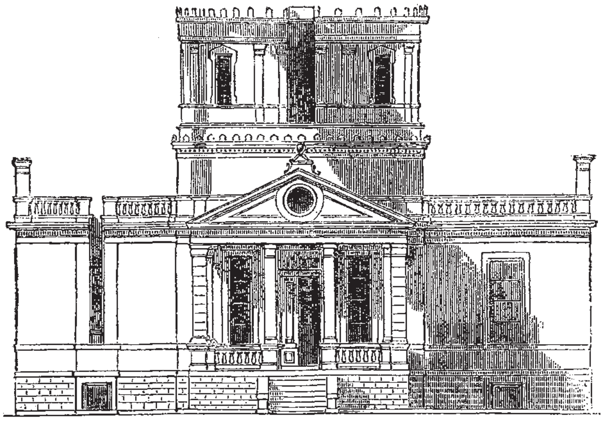

FIG. 3.—New Cincinnati Observatory—Front elevation.

But in 1838 a new call was made upon the Depôt, which turned the whole current of its future. The exploring expedition was about to sail for the South Seas. It would be of prime importance, in determining the longitude of places to be visited by the expedition, that corresponding astronomical observations should be made at home, to be compared on its return. Secretary Paulding gave the observations in the United States to Lieut. Gilliss, Wilkes's successor at the Depôt, and to Prof. Bond, of Cambridge. For the years 1838-42 Gilliss worked most accurately and unremittingly. With the help of an achromatic telescope, added by the Navy Department, and the transit before mentioned, he observed and recorded 10,000 transits; and his observations, afterwards tested by Prof. Peirce, were ranked by him among the highest then made. They are in the libraries of the astronomers of Europe. They procured, in fact, the founding of the present Naval Observatory.

For this, however, hard work in abundance was to be done. Gilliss urged the unsuitableness of his building erected alongside of Wilkes's wooden square room, and his want of space to erect a permanent circle. He won over the old [Navy Commissioners and the indorsement of the Secretary to their recommendation for something better. He pressed the Naval Committees frequently and closely, but enlisted scarcely one, except Mallory, of the House. Almost to a man they kept away from the Depôt, although it was "so near," and no help seemed available. But a celestial visitant now appeared, as, singularly enough, another did in 1843 for the benefit of the Cambridge Observatory. It gained the day for Gilliss, and for an observatory at Washington. He had closely observed Encke's comet, and read a paper on it before the National Institute. When he made, shortly after this, his last intended visit to the Senate Committee, Preston of South Carolina asked, "Are you the one who gave us notice of the comet? I will do all I can to help you." In a week a bill passed the Senate; and, strangely enough, passed the House also, without discussion, on the last day of its session. It appropriated 25,000 dols.; but still "for a Depôt of Charts and Instruments."

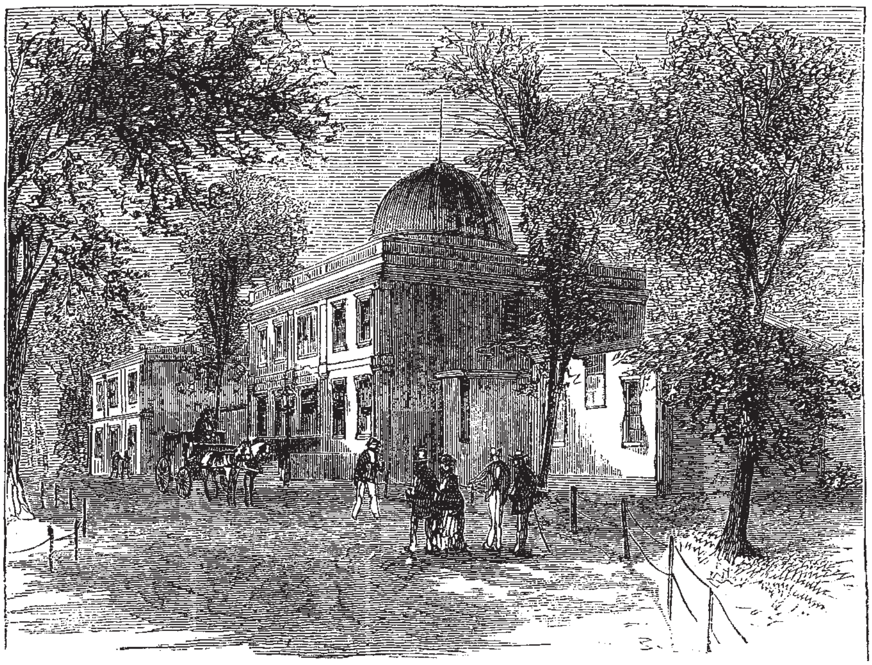

Fig. 4.—The United States Naval Observatory, Washington.

But the Secretary of the Navy was no longer officially bound by the name. The report of the committee, which secured the bill, was so expressly in favour of astronomical, meteorological, and magnetic objects, that Congress was justly understood to sanction them. Gilliss was sent abroad for instruments and plans for an observatory.

The site chosen by President Tyler for the building was fraught with historic interest. The square embraces a little more than nineteen acres in measurement. It is now tastefully laid out and ornamented. Nearly central within it stands the building represented in Fig. 4. It is on the second highest eminence within the city limits, commanding the view of the public buildings, of the neighbouring cities of Georgetown and Alexandria, and of Arlington.

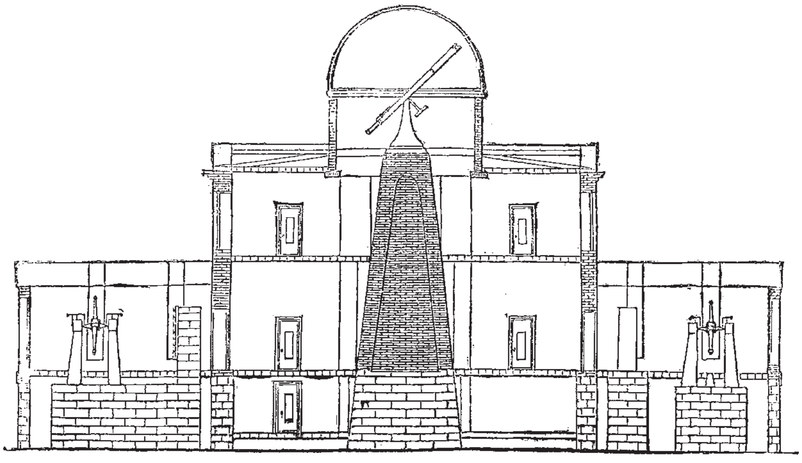

Fig. 5—Section of Main building—United States Naval Observatory, 1844.

In 1844 Gilliss reported the completion and equipment of the central building. He had secured the excellent equatorial, the meridian circle, the transit, prime vertical, and mural circle on which so much valued work has been done. He had begun a library, to which nearly 200 volumes of the highest standard works were presented by the Greenwich, Paris, Berlin, and Vienna institutions.

(*To be continued.*)